स्वामी रामानंद तीर्थ
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Title of Synopsis:

"Studies on diversity of insect pollinators in Agro ecosystem around Parbhani, M.S., India"

In the subject
Zoology
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SYNOPSIS

Abstract of proposed work plan/ problem:

1. Introduction:

A pollinator is an animal that moves pollen from the male anther of a flower to the female stigma of a flower. This helps to bring about fertilization of the ovules in the flower by the male gametes from the pollen grains. More than 250,000 species of flowering plants have been described, and an equivalent number could await discovery (Davies et al., 2004). Most of the terrestrial and many aquatic food webs, the angiosperms are the principal providers of nutrients and resources to most other organisms, and they provide multidimensional services for the majority of terrestrial and freshwater ecosystems. Humans derive food, fibres, drugs, and fuel, either directly or indirectly from angiosperms.

Pollination represents possibly one of the greatest areas of interaction between natural system and agricultural system. The consistent pollination service is one of the key factors supporting agricultural production but nowadays land use, anthropogenic activities, use of pesticides, insecticides etc have a substantial impact on pollinators. Cross pollinating plants require the services of an efficient pollination agent or vector, which may be biotic or abiotic depending upon the type of flower.

Among the abiotic vectors wind is predominant whereas amongst the biotic agents' birds, mammals, an insects play major role with the insects dominating the others. Studies have shown that insects, birds or bats pollinate 2/3rd of the world's flowering plants. Insect species and other animals pollinate more than 3/4th of the world's crop plants. Many rare, threatened / endangered plants are dependent on native pollinators.

Pollinators diversity and ecosystem health

Pollinator's diversity comprises a diverse group of animals that include species of butterflies, flies, moths, wasps, beetles, ants, birds, bats, monkeys, rodents, and reptiles, but are dominated by insects, particularly bees. Biodiversity loss during the Anthropocene is a serious ecological challenge (Daniel *et al.,* 2022). Research has indicated that in natural ecosystems, pollinator diversity enhances pollination during environmental and climatic disturbance, thus alleviating pollen limitations. Thus, effects on ecosystem health.

Pollinators decline

The existence of pollinator decline can be difficult to determine, a number of possible reasons such as exposure to pathogens, parasites, and pesticides; habitat destruction, climate change, market forces, intra and interspecific competition with native and exotic species. Researchers believe that long-term honey bee declines are the result of a complex set of factors. The primary

suspects are poor nutrition, pesticides, pathogens/parasites and poor quality of genetic stock (Pennstate Extension, 2022).

Habitat modification

The main three ways that habitat modifications affect pollinators species: modification of food sources, modification of nesting and modification of resting and mating sites. Multiple, anthropogenic pressures threaten insect pollinators. Land-use change and intensification alters the habitats and landscapes that provides food a nesting resources for pollinators (Adam 2014).

Pesticides

Pesticides effects include removing important flowers (food), and can impact reproduction, navigation and memory in pollinators. Exposure to pesticides can multiply the effects of other stressors on pollinator populations. Pesticides are commonly used in urban and agricultural environments to kill invertebrate pests, diseases, and weeds. However, many pesticides including insecticides, fungicides, and herbicides - harm pollinators and other beneficial insects (XERCES SOCIETY, 2020).

Pollution

Another factor influencing pollinator diversity and pollination that has recently been identified is air pollution. Observations revealed there were 62-70% fewer pollinator visits to the plants located in polluted air. This reduction was seen in seven pollinator groups, particularly bees, moths, hoverflies and butterflies. Common air pollutants such as those found in car exhaust fumes react with floral scents, leading to reduced pollination by insects, according to new research (Lis Kimbrough, 2022).

Exotic species / Migratory species:

Introduction of plants and pollinators to parts of the world where they do not naturally occur needs to be observed with great caution. The exotic plant communities have the ability to cause both direct and indirect impacts on pollinators. Invasive alien species modify pollinator biodiversity and the services they provide that underpin ecosystem function and human well-being (Adam *et al.,* 2014).

Environmental factors:

Environmental factors, such as temperature, relative humidity, and sunlight intensity, can affect pollination processes (Elgersma *et al.*, 1989). Environmental factors may be one of the factors responsible for the changing visitation rates of the pollinators.

2. Review of Literature and Development in the subject (Previous work done in the relevant area):

Occurrence of sex in plants was the ophast in 4th century B.C. by Aristotle proposed the existence of a relationship between bees and flowers. Sprengel (1793) put forward a theory stating the pollination in plants by pollinators. It was however, only in the end of 19th century

that plant reproduction and the mechanism of pollination were discovered by Muller (1882). the work of Darwin (1887) on hand and insect pollination techniques further helped in understanding the theories of plant perpetuation and vigour maintenance through cross pollination.

Jason M. Tylianakis (2010) investigated on 'Ensuring food production: native biodiversity provides pollination and biological control services.' Land use intensification drives extinctions of species and alters the ways in which they interact with one another. This loss of biodiversity may result in reduced rates of ecosystem services such as pollination and biological control, with loss of functional group and response diversity having the greatest effects on function.

Daniel *et al.*, (2022) worked on 'Pollinator diversity benefits natural and agricultural ecosystems, environmental health, and human welfare'. This research indicates that in natural ecosystems, pollinator diversity enhances pollination during environmental and climatic perturbations. In agricultural ecosystems, pollinator diversity increases the quality and quantity of crop yield. Pollinator groups are useful in monitoring environmental pollution, aid in pest and disease control.

Michael *et al.*, (2023) during their investigation on 'Forests are critically important to global pollinator diversity and enhance pollination in adjacent crops.' Although the importance of natural habitats to pollinator diversity is widely recognized, the value of forests to pollinating insects has been largely overlooked in many parts of the world. The protection of individual trees, will benefit pollinating insects and help maintain the critical services they provide.

3. Objectives of Research / Proposed Hypothesis:

There is insufficient information the taxonomy, extent and importance of the role of pollinators as crop pollinator in an-ecosystem health, a consequently on how serious the problem of decline in pollinator diversity is and how might grow. It is in this perspective that the present investigation has been planned with the following objective:

a) To monitor the numbers and diversity of pollinators of target crop systems and landscapes.

b) To compare the efficiencies of important pollinators and determine the most effective pollinator for specific representative crop plant.

c) To Identify the insect diversity from study area.

d) To suggest management and statistical analysis of the insect fauna.

The data would be helpful to the upcoming researchers and to plan the conservation strategies to be implemented in the study area.

4. Methodology to be adopted:

The present investigation will be carried out to study the pollinator diversity and the foraging behaviour of insect and other visitors of some important oil seed, vegetable, fruit and forest

plants. Also determining the most efficient visitor pollinator and their contribution in the health of the crop ecosystem by pollinating activity.

Field Surveys:

The field surveys were truly aimed at listing the insect fauna at selected sampling stations within three sites of study region; with a view to study their ecological as well as biological characters especially their species richness of the orders.

Study area / Limitations of research study:

The sampling will be carried out during seasons and crop cultivations. The investigations for selected crops will be conducted in the farmers field areas around Parbhani.

Study material:

Sampling is the primary tool for collecting innumerable data so as to understand certain parameters viz. ecology, distribution, composition, diversity, abundance, community structure etc. The primary goal of the sampling in the present study is to collect one to two specimens of each representative species with the help of pitfall trap, Light trap, Sweep net and as per need hand picking of insect specimens. The strategies considered are killing and sorting of insects into respective groups, their preservation, labelling, preliminary identification in the field and confirming them at the laboratory. To achieve these objectives the collection and preservation of various insects was done as per ZSI (1986, 1992) and Gadagkar *et al.,* (1990). Sweep net method will be carried out during investigations which is a powerful method for active flying insects as well as insects hidden in vegetation (Gadagkar *et al.*, 1990).

Killing, preservation and mounting:

After collection, the insects will be killed in a killing bottle. As per need they are placed properly in envelopes, liquid preservative etc. to avoid damage and will be brought to the laboratory for further studies. Both the dry and wet preservation methods will be utilized to preserve the specimens. Wet preservation will be carried out in 70% alcohol mixed with 5% formalin with few drops of glycerine. While for dry preservation, depending on insect specimens, they will be pinned, mounted on paper/card material and photographed and kept in an oven at 60°C for appropriate duration.

Labelling and storage of specimens:

The insect specimens preserved will be labelled serially and collection data will be recorded.

Identification:

To identify insect specimens up to the species level is a tedious task. However, by utilizing all the possible sources, attempts were made to identify the maximum number of insects. Identification includes available standard literature. The plant component comprised the

selected crops which are cultivated in the said area which are selected for the study and included:

Crops	Vegetable plants	Fruit plants
- Oil seed crops Sunflower (*Helianthus annuus*) and Soybean (*Glycine max*) - ***Seasonal observations will be carried out during full bloom period***	- Vegetable crops Brassica (*Cabbages*) and Okra (*Abelmoschus esculentus*) - ***Seasonal observations will be carried out during full bloom period***	- Papaya fruit (*Carica papaya*) and Sweet orange (*Citrus sinensis*) - ***Seasonal observations will be carried out during full bloom period***

Statistical analysis:

The insects identification will be appropriately listed for statistical analysis. For calculating the diversity index up to families Shannon-Wiener formula and Simpson Diversity formula (Simpson, 1949) will be applied.

1. Shannon-Welner Index:

$$H = -\sum_{i=1}^{S} p_i \ln p_i$$

Where,

Pi is the proportion of the W species in the community,

'S' is the total number of species, 'In' is the log with base 'e' (Pielou, 1975).

2. Simpson Diversity Index:

$$D = \sum_{i=1}^{S} \frac{n_i(n_i - 1)}{N(N-1)}$$

Where,

n is total number of organisms of a particular species,

N is the total number of organisms of all species

5. Importance of study/Society application:

Pollinators provide food, form habitats and provide a wide range of other resources for many animal species. Pollinators consequently play a key role in regulating ecosystem services supporting food production, habitats and natural resources. The two components, man and food are the intricately linked to each other in a complexity of relationships that in fact are responsible for the drastically changed environmental scenario around us. Pollinators are a very important bio-input which can contribute greatly in this direction

International status:

Over the past decade, the international community has increasingly recognised the importance of pollinators as an element of agricultural diversity supporting human livelihoods. Yet mounting evidence points to a potentially serious decline in populations of pollinators.

National Status:

Indian crops are sub optimally pollinated, and there's a risk of the situation getting much worse from insecticides and habitat loss. Indian pollinators have declined from their natural level by 40% in 2016. 9% of India's agricultural GDP depends directly on pollination.

Significance of the study:

This study helps in the process of fertilization by bringing the male gamete closer to the female. Thus, it helps in the production of fruits and seeds. These pollinating agents are important for the existence and reproduction species of plants. Pollinators are important to increase agriculture production and in ecosystem functions to increase plant genetic diversity.

6. Proposed work Plan/Formulation and Structure of Study: Year-wise Plan of the research work and targets to be achieved:

First Year	- Collection of references - Selection of field sites - Field visits - Seasonal observations of pollinators, collection and their identification
Second Year	- Collection of references - Selection of field sites - Field visits - Seasonal observations of pollinators, collection and their identification
Third Year	- Collection of references - Data collection and pollinators identifications - Theses writing work will be undertake

7. References:

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